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Holmes et al.

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(54) **DEVICES AND METHODS FOR REMANUFACTURING PRINTER CARTRIDGES**

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G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/1676*** (2013.01); ***G03G 15/0812*** (2013.01); *G03G 2215/00987* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0812; G03G 15/0894; G03G 21/181; G03G 2215/00987
USPC 399/109, 119, 174; 264/36.1
See application file for complete search history.

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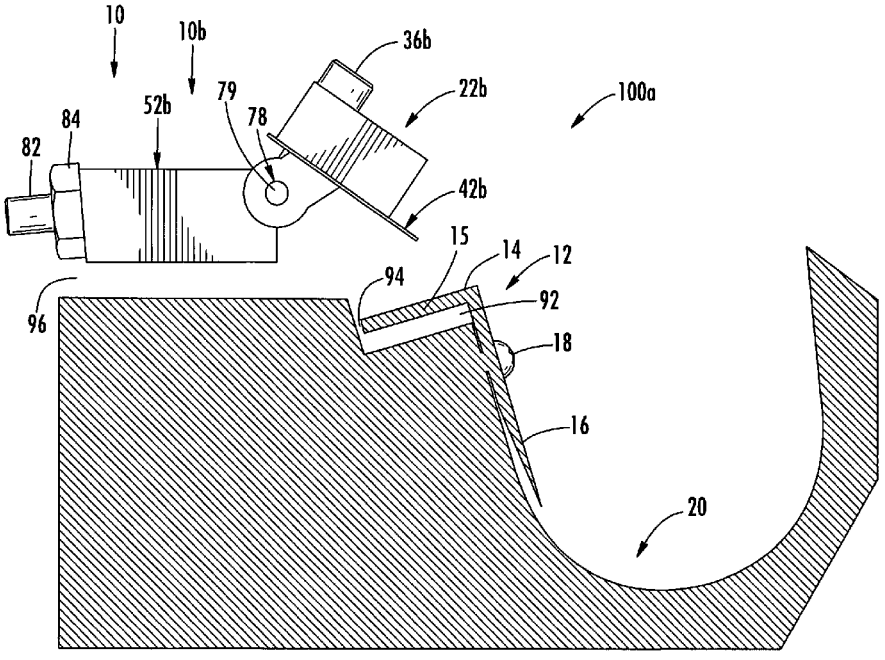
Primary Examiner — Erika J Villaluna

(57) **ABSTRACT**

There is provided in one embodiment a doctor blade alignment device for aligning a doctor blade in a toner hopper of a printer cartridge. The device has an alignment assembly portion with a doctor blade contact portion having at least two magnet elements and at least two blade adjustment elements. The device further has an adjustable setting blade attached to the alignment assembly portion and substantially coextensive in length with the alignment assembly portion. The device further has a base portion attached to the adjustable setting blade and substantially coextensive in length with the adjustable setting blade. The alignment assembly portion and the adjustable setting blade calibrate the doctor blade alignment device to obtain a doctor blade alignment setting for aligning a doctor blade in a toner hopper of a printer cartridge.

17 Claims, 11 Drawing Sheets



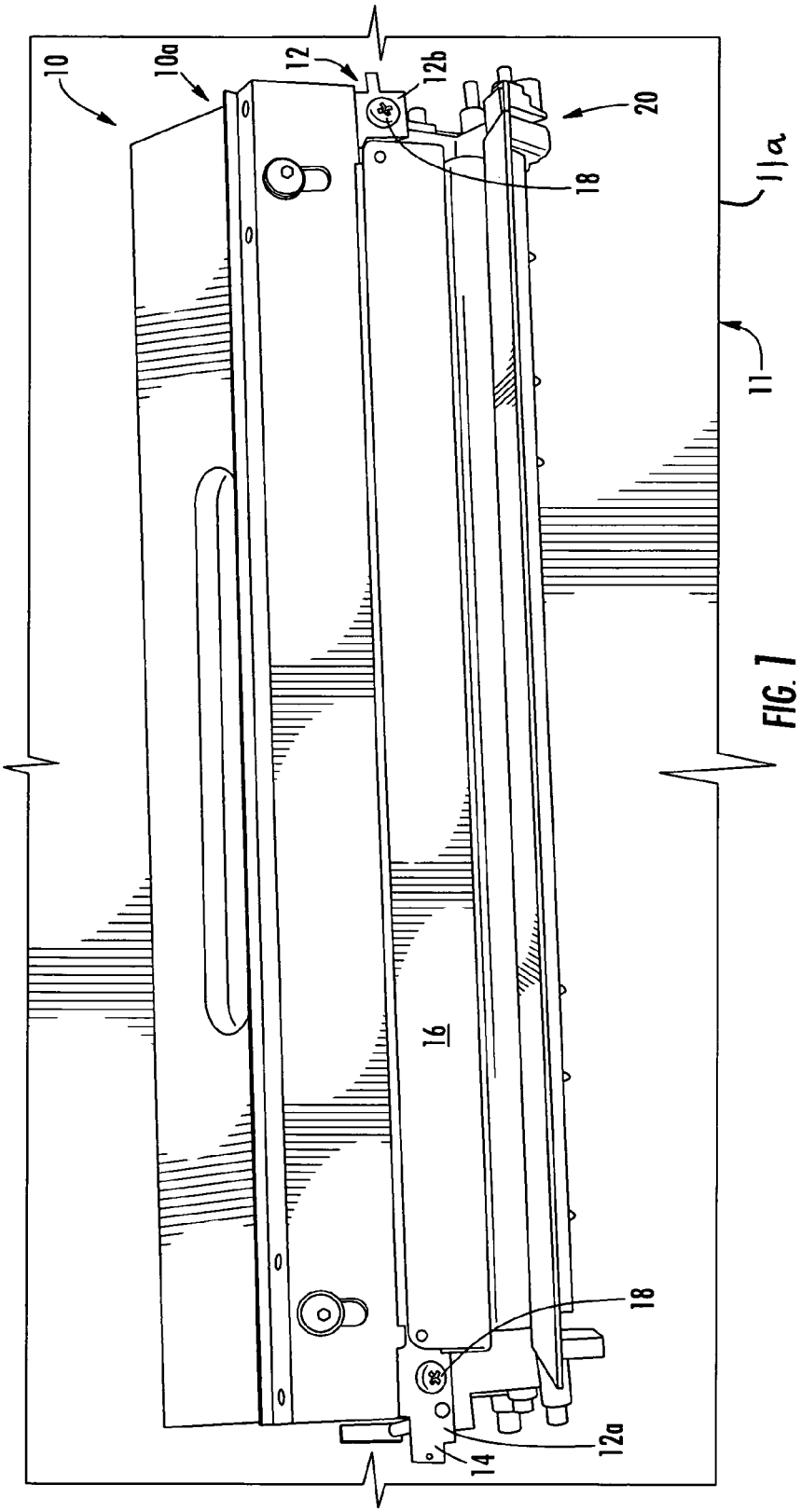
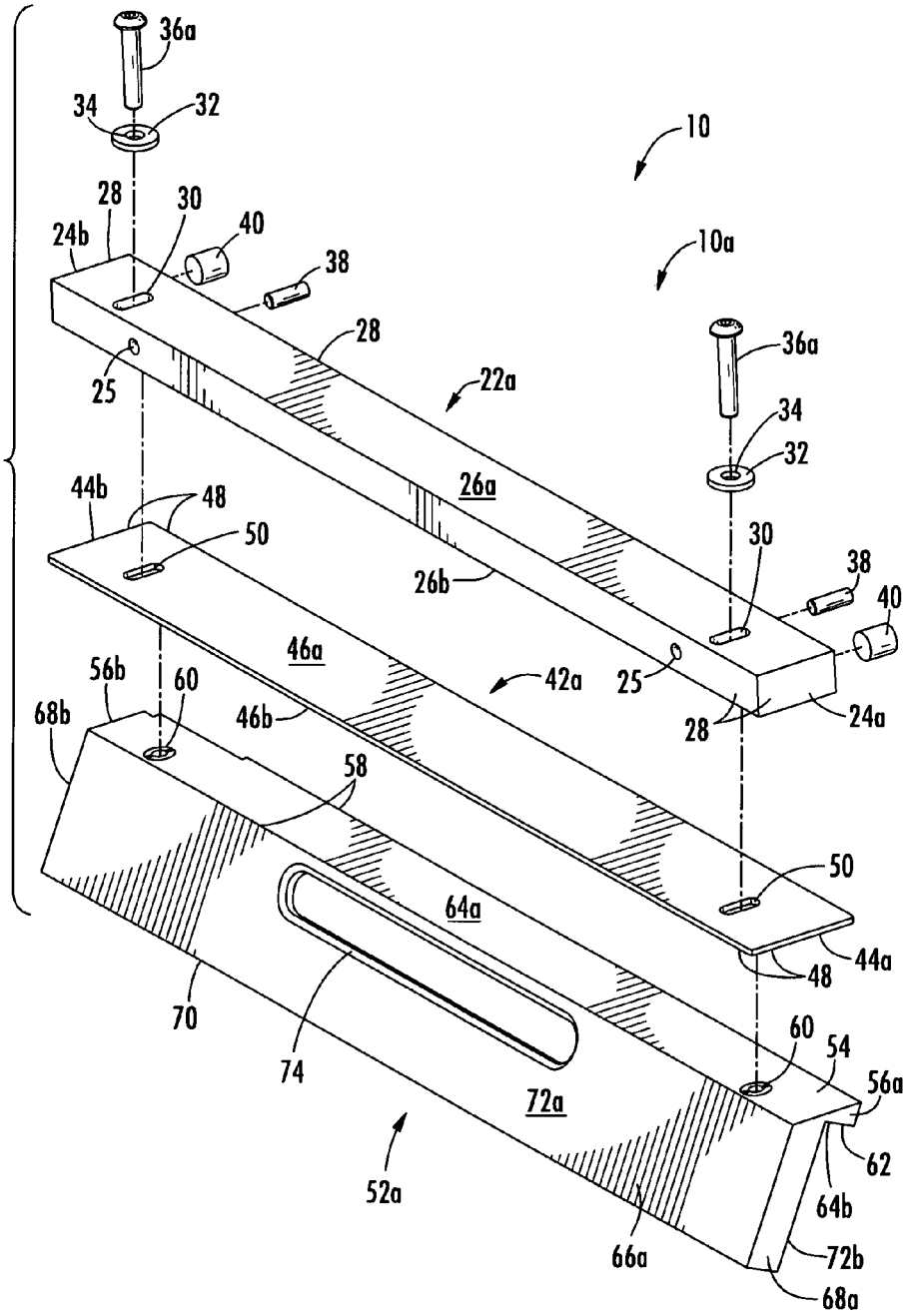


FIG. 1

FIG. 2A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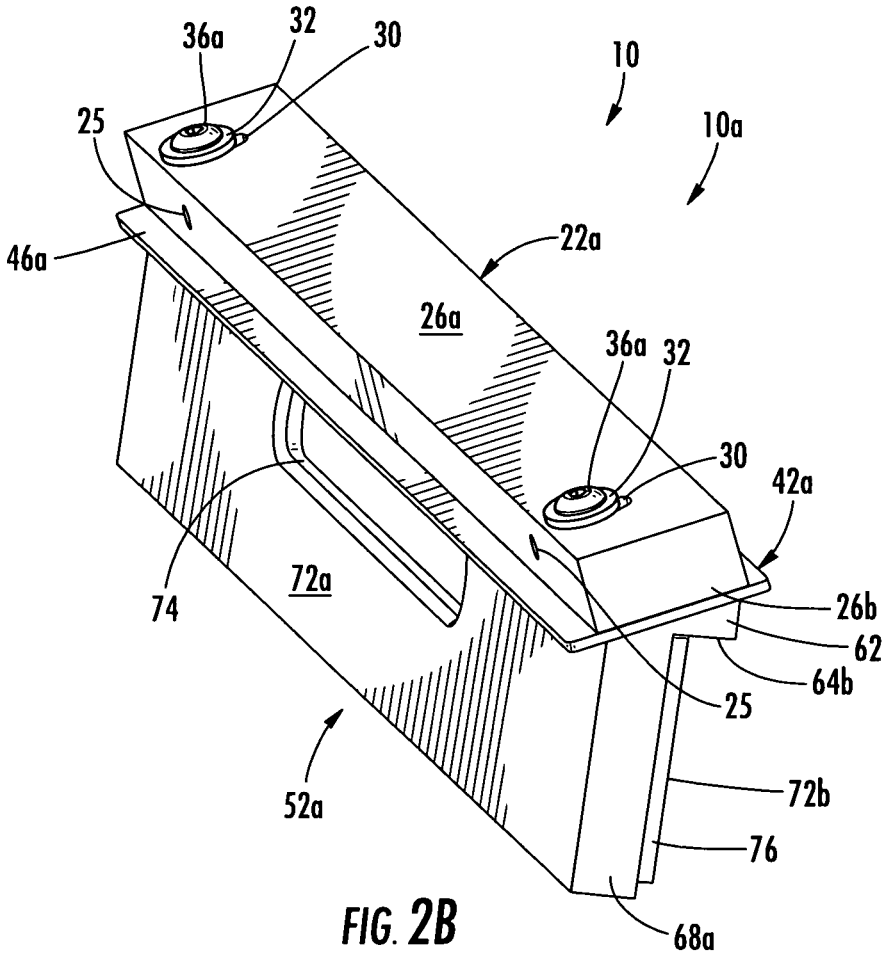
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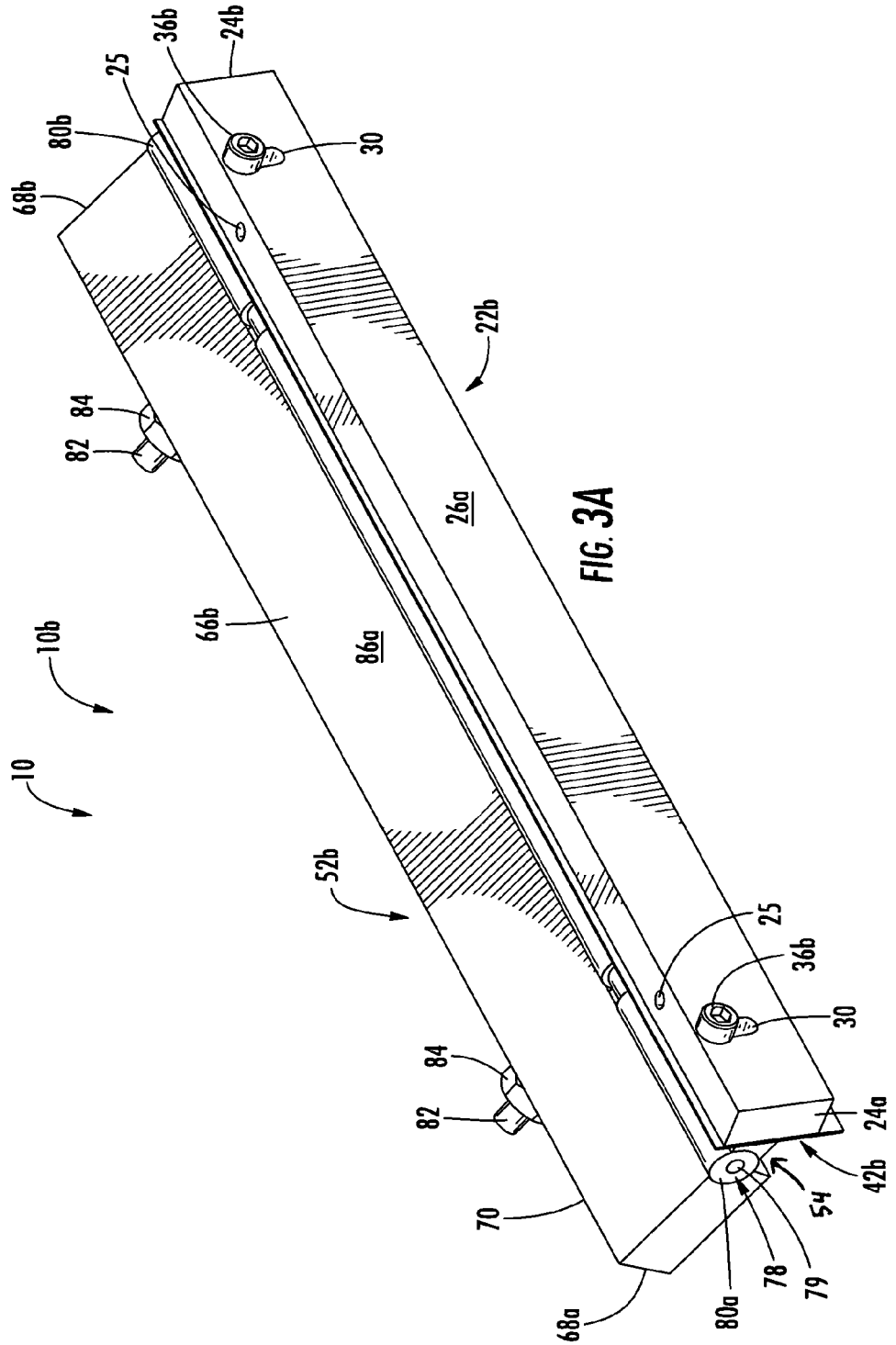
68a

FIG. 2B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86a
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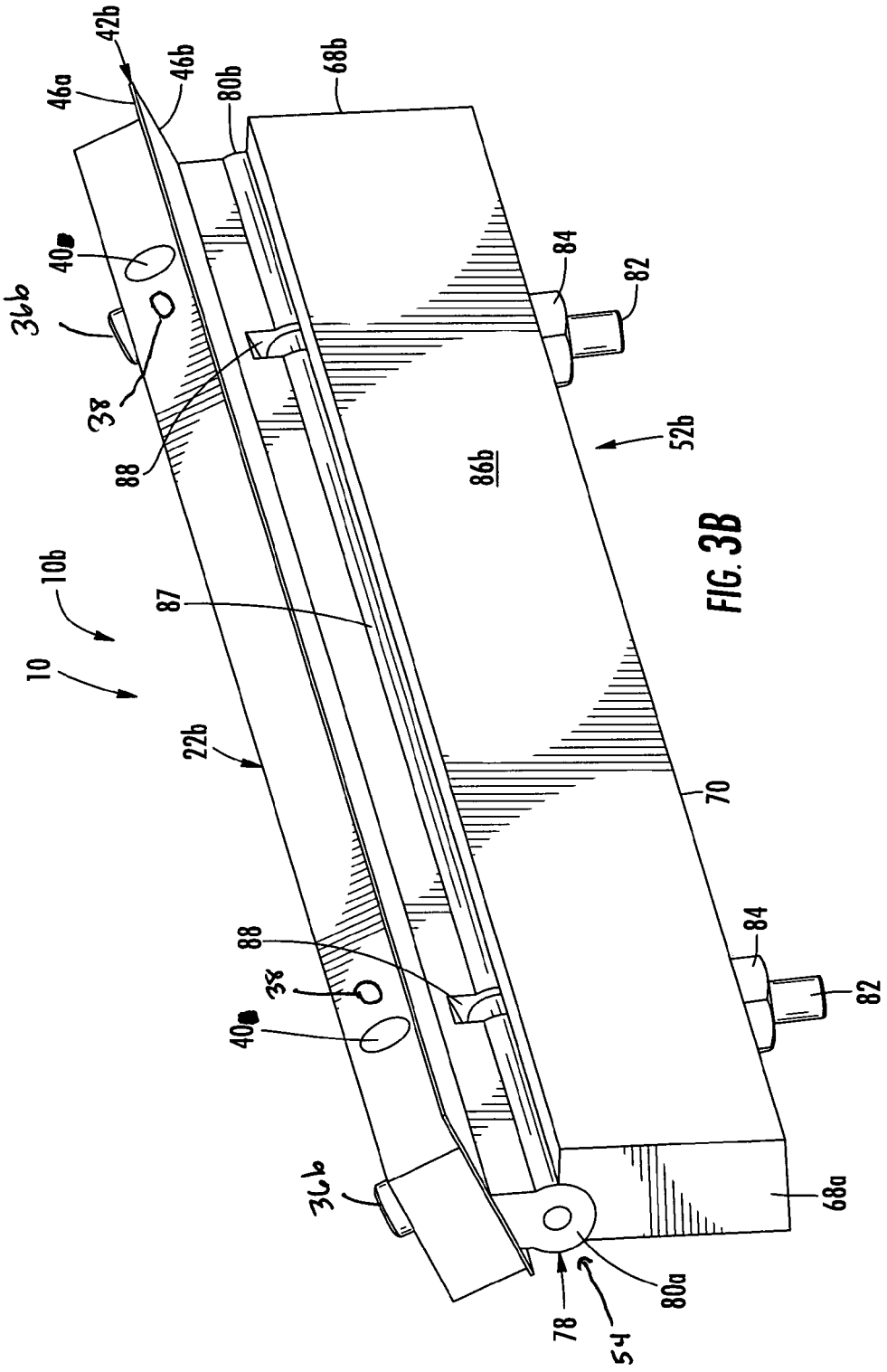
FIG. 3A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82
36b
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80a
78
54

FIG. 3B

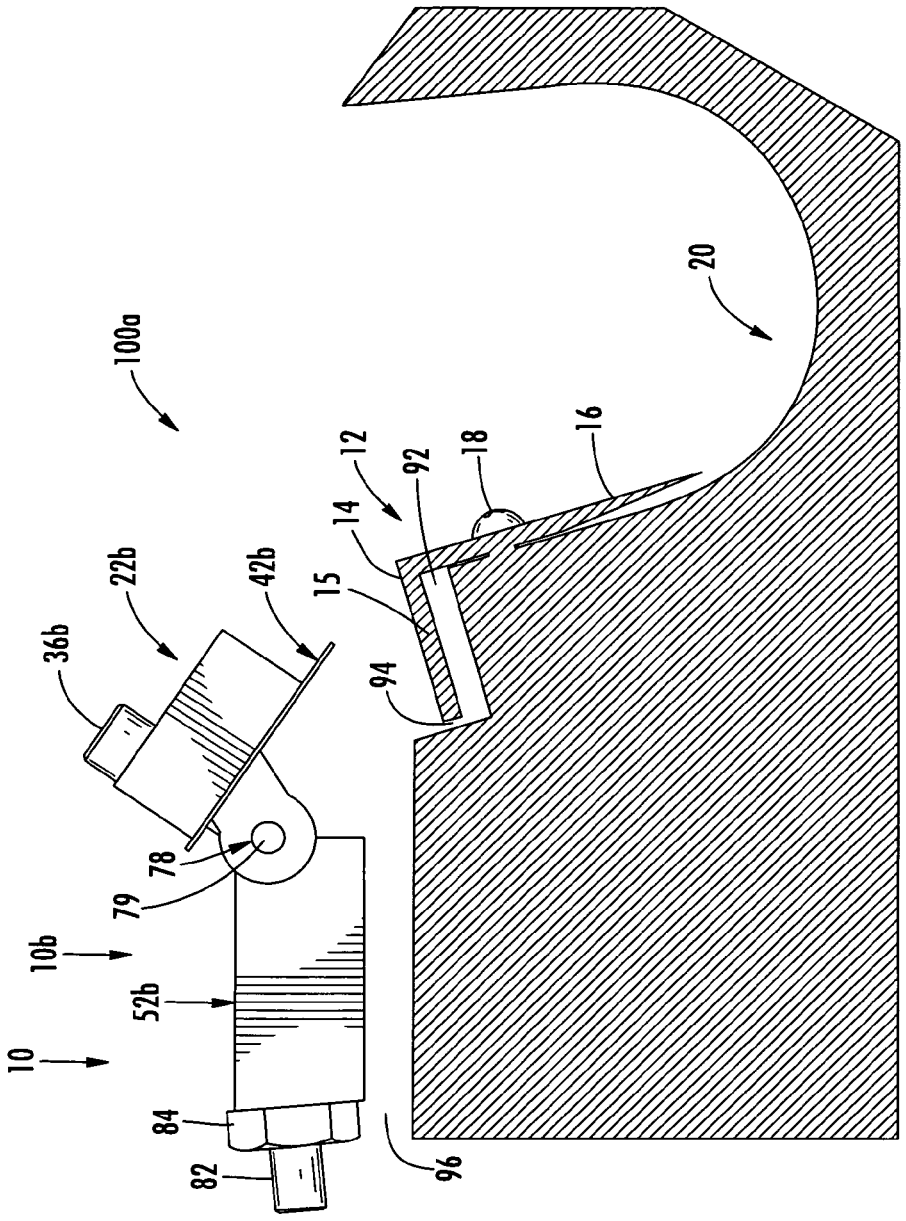

FIG. 3C

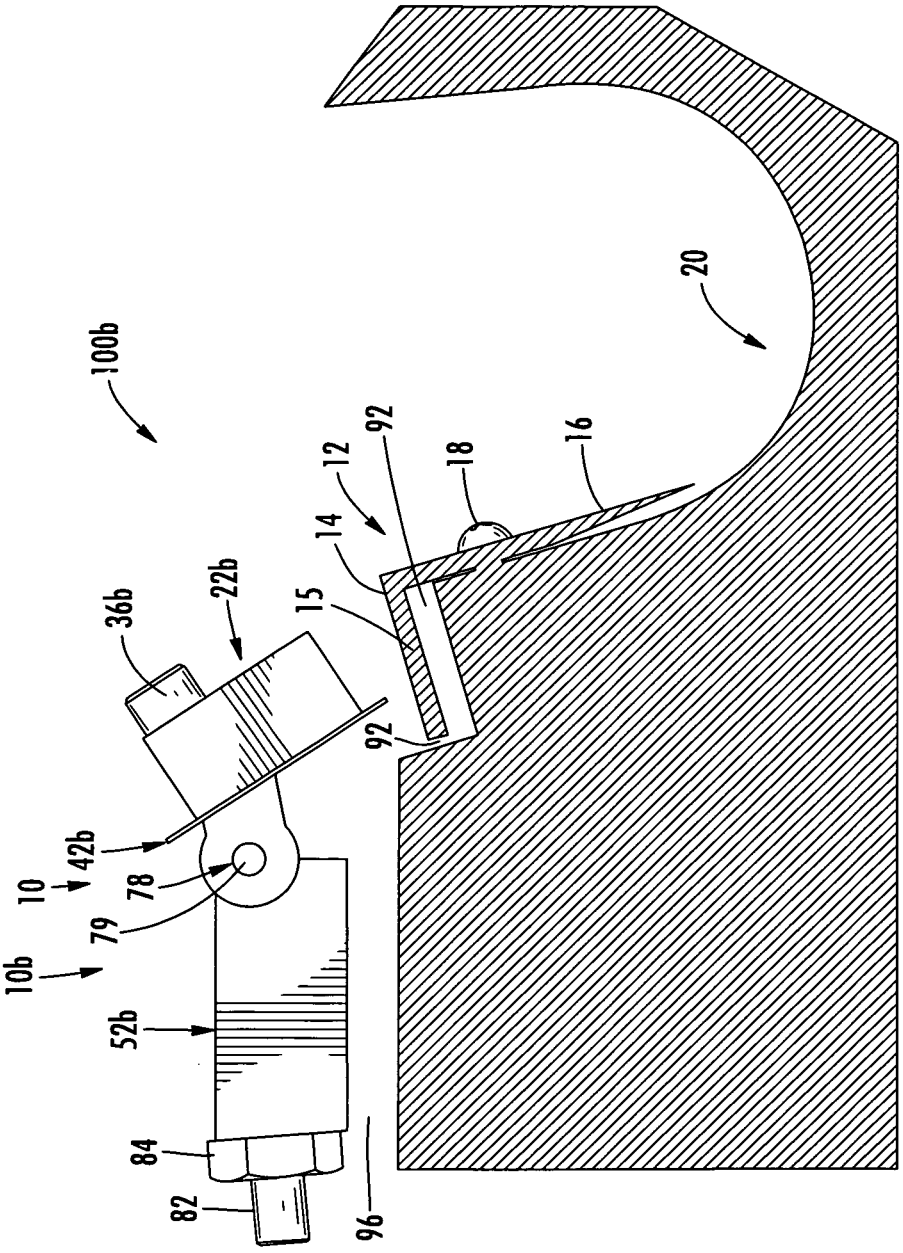

FIG. 3D

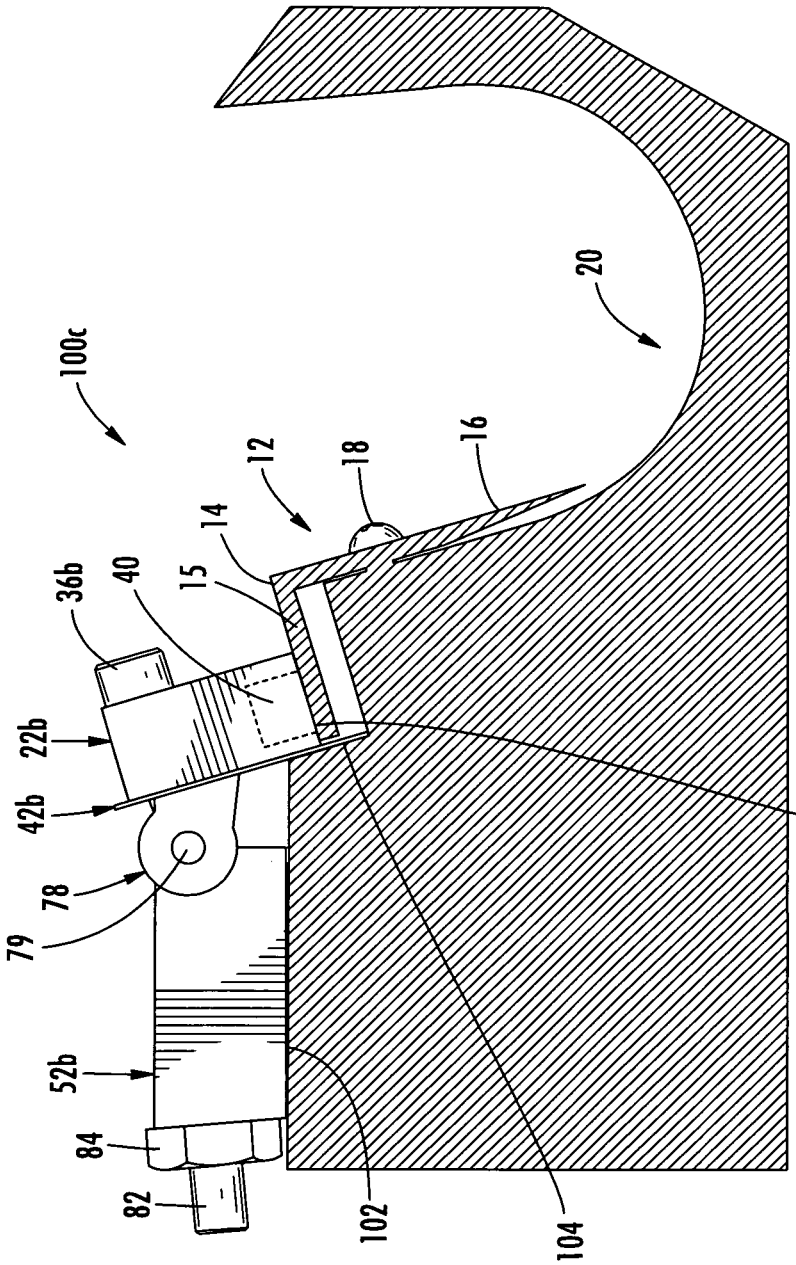

FIG. 3E

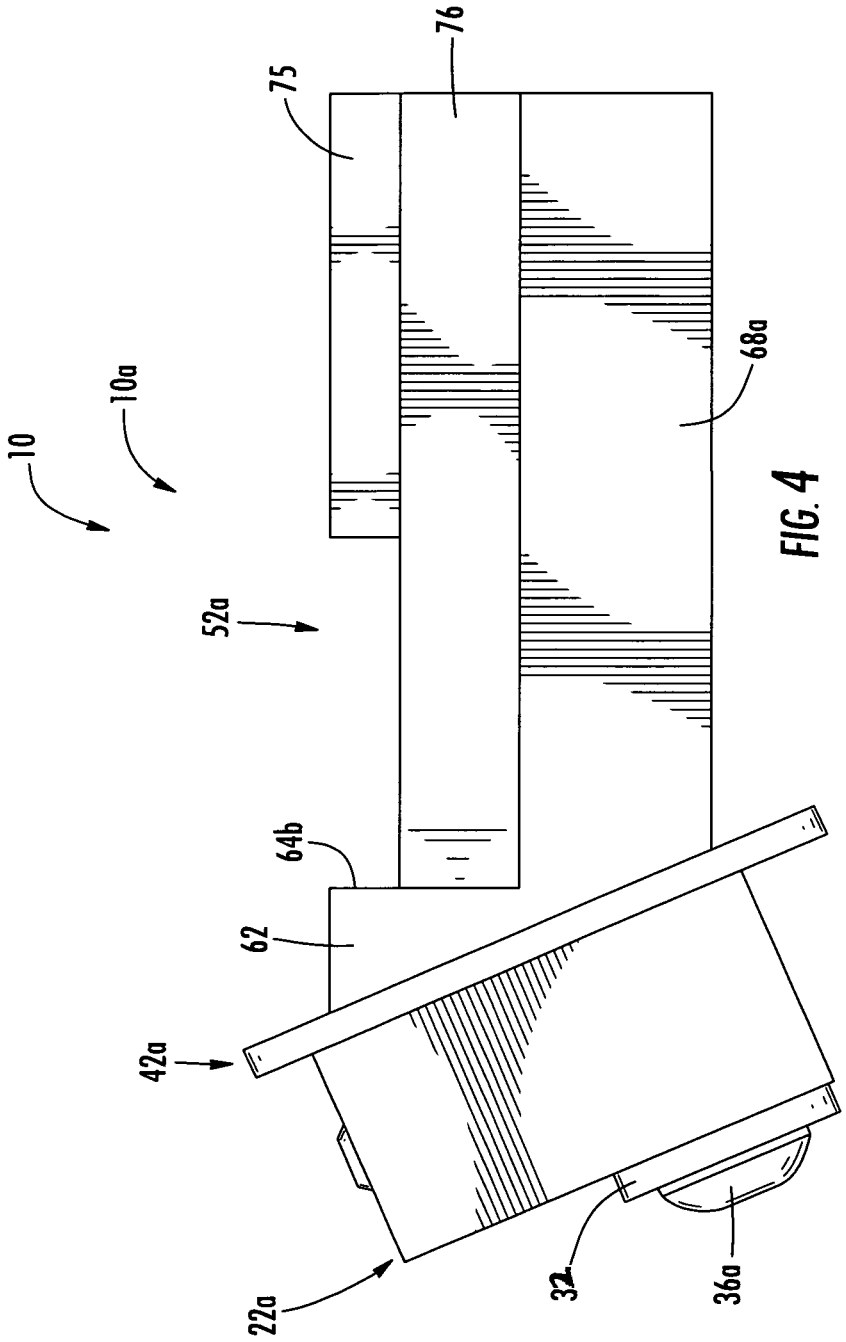

FIG. 4

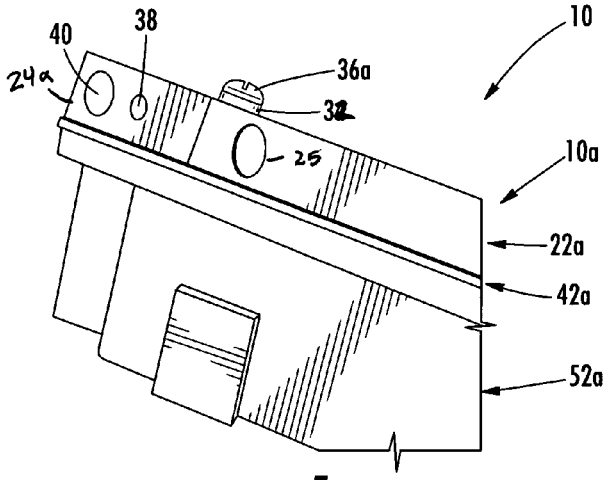
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FIG. 5

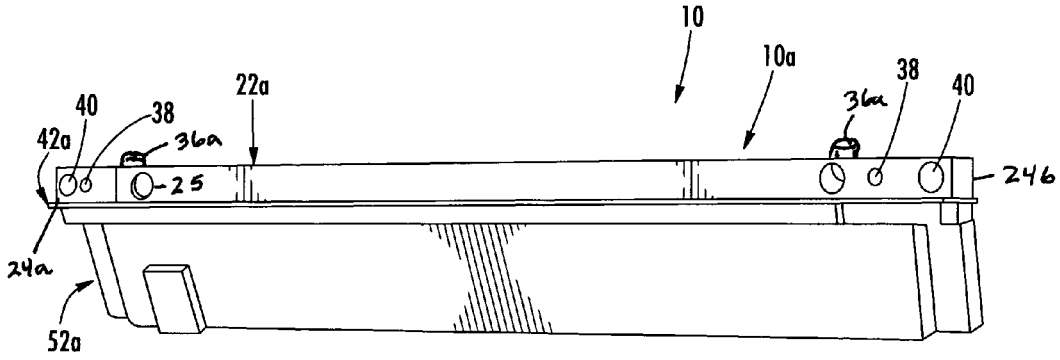
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FIG. 6

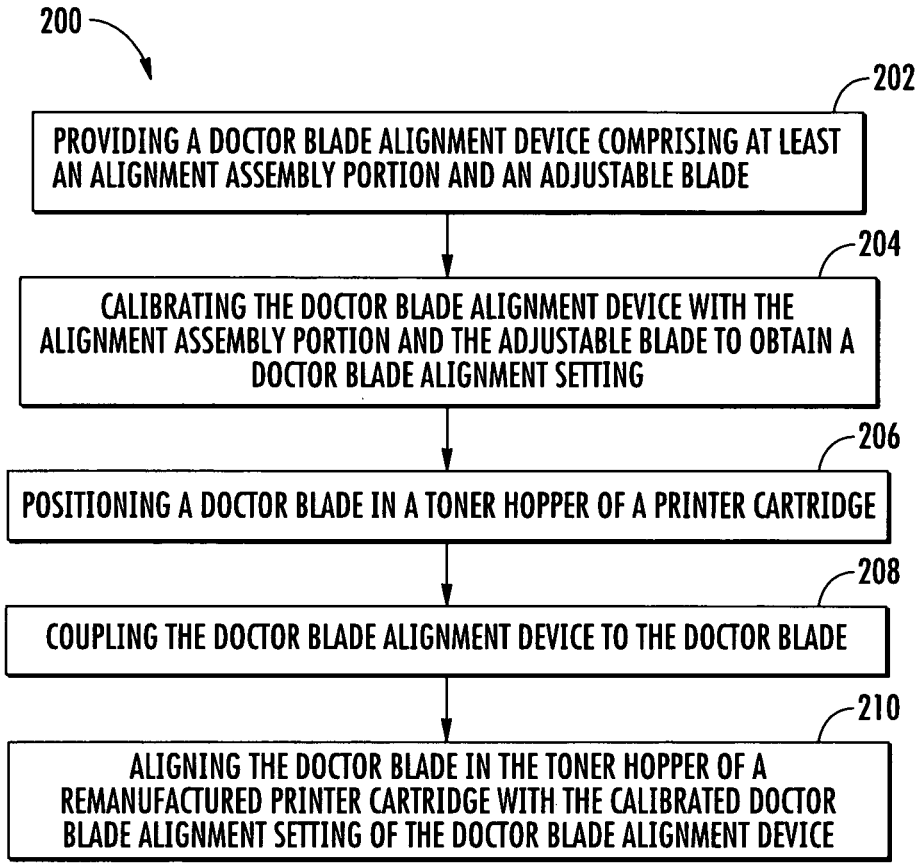
200
202
PROVIDING A DOCTOR BLADE ALIGNMENT DEVICE COMPRISING AT LEAST AN ALIGNMENT ASSEMBLY PORTION AND AN ADJUSTABLE BLADE
204
CALIBRATING THE DOCTOR BLADE ALIGNMENT DEVICE WITH THE ALIGNMENT ASSEMBLY PORTION AND THE ADJUSTABLE BLADE TO OBTAIN A DOCTOR BLADE ALIGNMENT SETTING
206
POSITIONING A DOCTOR BLADE IN A TONER HOPPER OF A PRINTER CARTRIDGE
208
COUPLING THE DOCTOR BLADE ALIGNMENT DEVICE TO THE DOCTOR BLADE
210
ALIGNING THE DOCTOR BLADE IN THE TONER HOPPER OF A REMANUFACTURED PRINTER CARTRIDGE WITH THE CALIBRATED DOCTOR BLADE ALIGNMENT SETTING OF THE DOCTOR BLADE ALIGNMENT DEVICE

FIG. 7

DEVICES AND METHODS FOR REMANUFACTURING PRINTER CARTRIDGES

BACKGROUND

a. Field of the Invention

The disclosure relates to electrophotography, and in particular, devices and methods for manufacturing or remanufacturing toner printer cartridges

b. Background Art

Printer cartridges, such as toner printer cartridges, are used in various electrophotographic imaging devices, such as laser printers, copiers, facsimile machines, and multifunction imaging devices. Once original equipment manufacturer (OEM) toner printer cartridges are used, they are often recycled and remanufactured. The process of remanufacturing a toner printer cartridge may include cleaning the cartridge, repairing damaged parts, replacing worn parts, reassembling with new parts, and replenishing the cartridge with toner. The process of remanufacturing a toner printer cartridge requires that the toner printer cartridge be disassembled so that access to the various component parts may be achieved, and further requires that the toner printer cartridge be reassembled for subsequent use.

The component parts of toner printer cartridges typically include a toner hopper, a waste hopper, a doctor blade or doctor bar, a primary charge roller (PCR), a developer roller, and an organic photoconductive (OPC) drum. The term "doctor blade" is a commonly used term in the toner printer cartridge manufacturing and remanufacturing industries and refers to an elongated material that usually includes an elongated rod with an elongated blade attached to the elongated rod. The elongated rod is usually made of metal, and the elongated blade may be made of plastic or metal. The blade may be positioned at an angle from the rod and may be positioned proximate to the developer roller with a predetermined distance.

When the toner printer cartridge is in operation, the doctor blade is typically stationary while the developer roller rolls next to the blade. The doctor blade ensures that the right amount of toner sticks to the developer roller. However, not all toner may be absorbed by the developer roller. The toner that is not absorbed by the developer roller typically accumulates around the developer roller. Since the doctor blade and the developer roller are separated by a relatively small predetermined space, the blade controls the thickness of the toner that adheres to the developer roller by scraping off toner that is not absorbed by the developer roller. If there is an excess amount of toner on the developer roller, the doctor blade scrapes off the excess amount. The developer roller then transfers the toner to the OPC drum. The OPC drum that is coated with toner then rolls over a sheet of paper, which is usually given a negative charge by the PCR. The charge of the paper is typically less negative than the charge of the toner, and thus the paper attracts the toner. The toner may be embedded on the paper according to the print pattern.

The doctor blade and the developer roller are usually detached from the toner printer cartridge during the remanufacturing process for cleaning. After cleaning, the doctor blade and the developer roller may be reassembled together usually manually with a screw driver. An assembler or user may align or position the doctor blade above the developer roller. The assembler or user may press on one side of the doctor blade and then attach with attachment means, such as screws, the same side of the doctor blade to the toner printer cartridge. The assembler or user may then execute the same steps on the remaining side. Aligning and positioning the doctor blade during replacement and remanufacture may require that the doctor blade be aligned or positioned within a few millimeters of an acceptable alignment or position point to maximize print quality during printing. Many known OEM toner printer cartridges are designed to have a doctor blade that may have the capability of being adjustable in order to adjust the doctor blade position. Thus, it may be difficult for the remanufacturer to manually align the doctor blade to the correct position.

Known methods of assembly, manufacture, or remanufacture of toner printer cartridges may not provide a uniform distance between the doctor blade and the developer roller from one side of the doctor blade to the other. As a result, the print quality may be affected, as the toner level on the developer roller is not effectively regulated by the doctor blade. One side of the developer roller may produce darker images than the other, or vice-versa. Moreover, known methods of assembly, manufacture, or remanufacture of toner printer cartridges, such as positioning or aligning a doctor blade, may require an assembler or user to manually align and position the doctor blade and may result in misalignment or damage to the doctor blade. For example, an assembler or user may have to manually hold the doctor blade in order to tighten fasteners such as screws to secure the doctor blade to the toner hopper.

In addition, known methods of assembly or remanufacture of toner printer cartridges may require permanent attachment of two or more spacers, inserts, shims, or other spacing elements within the gap or area formed between the doctor blade and the printer cartridge body in order to maintain a desired gap or area distance. The use of such permanent spacers, inserts, shims, or other spacing elements may increase the overall cost and complexity and decrease the overall efficiency of the assembly, manufacturing, or remanufacturing processes. Moreover, such spacers, inserts, shims, or spacing elements may have to have a required thickness that may limit the type of spacer, insert, shim, or spacing element that may be used.

Accordingly, there is a need for an improved device and method for assembling, manufacturing, and remanufacturing toner printer cartridges, including aligning doctor blades, that overcomes the issues associated with known devices and methods.

SUMMARY

This need for an improved device and method for remanufacturing toner printer cartridges, including aligning doctor blades, is satisfied.

There is provided in one embodiment a doctor blade alignment device for aligning a doctor blade in a toner hopper of a printer cartridge. The doctor blade alignment device comprises an alignment assembly portion comprising a doctor blade contact portion with at least two magnet elements and at least two blade adjustment elements. The doctor blade alignment device further comprises an adjustable setting blade attached to the alignment assembly portion and substantially coextensive in length with the alignment assembly portion. The doctor blade alignment device further comprises a base portion attached to the adjustable setting blade and substantially coextensive in length with the adjustable setting blade. The alignment assembly portion and the adjustable setting blade calibrate the doctor blade alignment device to obtain a doctor blade alignment setting for aligning a doctor blade in a toner hopper of a printer cartridge.

There is provided in another embodiment a doctor blade alignment device for aligning a doctor blade in a toner hopper

of a remanufactured printer cartridge. The doctor blade alignment device comprises an alignment assembly portion comprising a doctor blade contact portion with at least two magnet elements, at least two setting pin elements, and at least two blade adjustment elements. The doctor blade alignment device further comprises an adjustable setting blade attached to the alignment assembly portion and substantially coextensive in length with the alignment assembly portion. The doctor blade alignment device further comprises a base portion substantially coextensive in length with the adjustable setting blade. The alignment assembly portion and the adjustable setting blade set the doctor blade alignment device to obtain a doctor blade alignment setting for aligning a doctor blade in a toner hopper of a remanufactured printer cartridge.

There is provided in another embodiment a method for aligning a doctor blade in a toner hopper of a printer cartridge. The method comprises the step of providing a doctor blade alignment device comprising at least an alignment assembly portion and an adjustable setting blade. The method further comprises the step of calibrating the doctor blade alignment device with the alignment assembly portion and the adjustable setting blade to obtain a doctor blade alignment setting. The method further comprises the step of positioning a doctor blade in a toner hopper of a printer cartridge. The method further comprises the step of coupling the doctor blade alignment device to the doctor blade. The method further comprises the step of aligning the doctor blade in the toner hopper of the printer cartridge with the doctor blade alignment setting of the doctor blade alignment device.

The above description sets forth, rather broadly, a summary of the disclosed embodiments so that the detailed description that follows may be better understood and contributions of the invention to the art may be better appreciated. Some of the disclosed embodiments may not include all of the features or characteristics listed in the above summary. There may be, of course, other features of the disclosed embodiments that will be described below and may form the subject matter of claims. The features, functions, and advantages that have been discussed can be achieved independently in various embodiments of the disclosure or may be combined in yet other embodiments further details of which can be seen with reference to the following description and drawings.

DESCRIPTION OF DRAWINGS

The invention can be better understood with reference to the following detailed description taken in conjunction with the accompanying drawings which illustrate preferred and exemplary embodiments, but which are not necessarily drawn to scale, wherein:

FIG. **1** shows a front perspective view of one of the embodiments of a doctor blade alignment device of the disclosure attached to a doctor blade in a toner hopper of a printer cartridge;

FIG. **2**A shows a perspective exploded view of one of the embodiments of a doctor blade alignment device of the disclosure;

FIG. **2**B shows a perspective assembled view of the doctor blade alignment device of FIG. **2**A;

FIG. **3**A is a back perspective view of another one of the embodiments of a doctor blade alignment device of the disclosure;

FIG. **3**B is a front perspective view of the doctor blade alignment device of FIG. **3**A;

FIG. **3**C is a side perspective view of the doctor blade alignment device of FIG. **3**A in a first pre-alignment position with respect to a doctor blade in a toner hopper;

FIG. **3**D is a side perspective view of the doctor blade alignment device of FIG. **3**C in a second pre-alignment position with respect to a doctor blade in a toner hopper;

FIG. **3**E is a side perspective view of the doctor blade alignment device of FIG. **3**D in an alignment position with respect to a doctor blade in a toner hopper;

FIG. **4** is a side view of one of the embodiments of a doctor blade alignment device of the disclosure;

FIG. **5** is a partial front view of one of the embodiments of a doctor blade alignment device of the disclosure;

FIG. **6** is a front view of the doctor blade alignment device of FIG. **5**; and,

FIG. **7** is an illustration of a flow diagram of an embodiments of a method of the disclosure.

DETAILED DESCRIPTION

Disclosed embodiments will now be described more fully herein after with reference to the accompanying drawings, in which some, but not all disclosed embodiments are shown. Indeed, several different embodiments may be provided and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete and will fully convey the scope of the disclosure to those skilled in the art. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the invention. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

The order in which the steps are presented below is not limited to any particular order and does not necessarily imply that they have to be performed in the order presented. It will be understood by those of ordinary skill in the art that the order of these steps can be rearranged and performed in any suitable manner. It will further be understood by those of ordinary skill in the art that some steps may be omitted or added and still fall within the spirit of the invention.

The disclosed embodiments provide various devices and methods for remanufacturing printer cartridges, such as toner printer cartridges, and in particular, for aligning and positioning a doctor blade in a toner hopper of a toner printer cartridge or remanufactured toner printer cartridge or for aligning and positioning a calibration doctor blade in a calibration toner hopper of a calibration toner printer cartridge. The disclosed embodiments of the devices and methods may be used with toner printer cartridges that can be used in laser printer engine models, such as, Hewlett Packard (HP) Company families of laser printer engine models, for example, HPM451, HP3525, HP4525, HP5525, or other suitable laser printer engine models.

Embodiments of a doctor blade alignment device **10** (see FIG. **1**), such as in the form of a hand-held doctor blade alignment device **10***a* (see FIG. **2***a*), and a mountable doctor blade alignment device **10***b* (see FIG. **3**A), and related alignment method **200** (see FIG. **7**) are provided. Referring to the Figures, FIG. **1** shows a front perspective view of one of the embodiments of a doctor blade alignment device **10**, such as in the form of doctor blade alignment device **10***a*, of the disclosure attached to a doctor blade **12** in a toner hopper **20** of a printer cartridge **11**, such as a remanufactured printer cartridge **11***a*. The printer cartridge **11** is preferably a toner printer cartridge for use in electrophotographic imaging devices, such as laser printers, copiers, facsimile machines, multifunction imaging devices, or another suitable electrophotographic imaging device. As shown in FIG. **1**, the printer cartridge **11** includes the toner hopper **20** with the doctor

blade **12** positioned in the toner hopper **20**. As shown in FIG. **1**, the doctor blade **12** comprises a first mounting end **12***a*, a second mounting end **12***b*, a support portion **14**, and a blade portion **16** attached to the support portion **14** with fastener members **18**, such as in the form of screws, bolts, or another suitable fastener member. The printer cartridge **11** may also comprise other known components such as a developer roller (not shown), end caps (not shown), organic photoconductor (not shown), and other suitable components.

There is provided in one embodiment a doctor blade alignment device **10** for aligning a doctor blade **12** in a toner hopper **20** of a printer cartridge **11**. FIG. **2**A shows a perspective exploded view of one of the embodiments of a doctor blade alignment device **10**, such as in the form of a hand-held doctor blade alignment device **10***a*, of the disclosure. FIG. **2**B shows a perspective assembled view of the doctor blade alignment device **10**, such as in the form of the hand-held doctor blade alignment device **10***a*, of FIG. **2**A. As shown in FIGS. **2**A-**2**B, the doctor blade alignment device **10**, such as in the form of a hand-held doctor blade alignment device **10***a*, comprises an alignment assembly portion **22***a*. The alignment assembly portion **22***a* (see FIGS. **2**A-**2**B) comprises a doctor blade contact portion **26***a* preferably in the form of an elongated rectangular bar **26***b*. As shown in FIG. **2**A, the doctor blade contact portion **26***a* comprises a first end **24***a*, a second end **24***b*, a plurality of sidewalls **28**, such as four sidewalls **28**, and at least two openings **25** (see also FIG. **2**B) along one of the sidewalls **28**. As shown in FIGS. **2**A-**2**B, the doctor blade contact portion **26***a* further comprises two slot through openings **30**. The slot through openings **30** are preferably spaced apart from each other and with one slot through opening **30** formed through the surface of the doctor blade contact portion **26***a* near the first end **24***a*, and one slot through opening **30** formed through the surface of the doctor blade contact portion **26***a* near the second end **24***b*.

As shown in FIG. **2**A, the alignment assembly portion **22***a* further comprises at least two magnet elements **40**. The at least two magnet elements **40** are spaced apart along the doctor blade contact portion **26***a* and are configured to contact the support portion **14** (see FIG. **1**) of the doctor blade **12** (see FIG. **1**) during alignment of the doctor blade **12** in the toner hopper **20** (see FIG. **1**).

As shown in FIGS. **2**A-**2**B, the alignment assembly portion **22***a* further comprises at least two blade adjustment elements **36***a*, such as in the form of screws, bolts, or other suitable insertable fastener-type devices. Each blade adjustment element **36***a* (see FIGS. **2**A-**2**B) may be inserted through a collar device **32** (see FIGS. **2**A-**2**B), such as a washer or the like, having an insertion opening **34** (see FIG. **2**A). As shown in FIGS. **2**A-**2**B, each blade adjustment element **36***a* is preferably configured for insertion through the collar device **32** and insertion through each respective slot through opening **30** in the doctor blade contact portion **26***a*. Each slot through opening **30** is configured to receive each blade adjustment element **36***a*.

As shown in FIG. **2**A, the alignment assembly portion **22***a* further comprises at least two setting pin elements **38** spaced apart along the doctor blade contact portion **26***a* and configured to contact the support portion **14** (see FIG. **1**) of the doctor blade **12** (see FIG. **1**) during alignment of the doctor blade **12** in the toner hopper **20** (see FIG. **1**). The at least two setting pin elements **38** preferably maintain a repeatable tolerance for the doctor blade alignment setting.

FIG. **5** is a partial front view of one of the embodiments of the doctor blade alignment device **10**, such as in the form of the hand-held doctor blade alignment device **10***a*, of the disclosure. FIG. **6** is a front view of the doctor blade alignment device **10**, such as in the form of the hand-held doctor blade alignment device **10***a*, of FIG. **5**. As shown in FIGS. **5**, **6**, one magnet element **40** and one setting pin element **38** are shown inserted in the alignment assembly portion **22***a* near the first end **24***a* (see FIG. **2**A) of the alignment assembly portion **22***a*, and another magnet element **40** and another setting pin element **38** are shown inserted in the alignment assembly portion **22***a* near the second end **24***b* (see FIG. **2**A) of the alignment assembly portion **22***a*, with only the end faces of each magnet element **40** and each setting pin element **38** exposed. FIGS. **5**, **6** further show the blade adjustment elements **36***a* inserted through the alignment assembly portion **22***a*. FIGS. **5**, **6** further show an adjustable setting blade **42***a* and a base portion **52***a*, both discussed in detail below.

As shown in FIGS. **2**A-**2**B, the doctor blade alignment device **10**, such as in the form of a hand-held doctor blade alignment device **10***a*, further comprises an adjustable setting blade **42***a* that is preferably attached to the alignment assembly portion **22***a* and is substantially coextensive in length with the alignment assembly portion **22***a*. As shown in FIGS. **2**A-**2**B, the adjustable setting blade **42***a* preferably comprises an elongated rectangular blade **46***a* comprised of a metal material, such as stainless steel, steel, or another suitable metal material. As shown in FIG. **2**A, the adjustable setting blade **42***a* further comprises a first end **44***a*, a second end **44***b*, and a plurality of straight edges **48**, such as four straight edges **48**. As shown in FIG. **2**A, the adjustable setting blade **42***a* further comprises two slot through openings **50**. The slot through openings **50** are preferably spaced apart from each other and with one slot through opening **50** formed through the surface of the adjustable setting blade **42***a* near the first end **44***a*, and one slot through opening **50** formed through the surface of the adjustable setting blade **42***a* near the second end **44***b*.

As shown in FIGS. **2**A-**2**B, the doctor blade alignment device **10**, such as in the form of a hand-held doctor blade alignment device **10***a*, further comprises a base portion **52***a* that is preferably attached to the adjustable setting blade **42***a* and is substantially coextensive in length with the adjustable setting blade **42***a* as well as substantially coextensive in length with the alignment assembly portion **22***a*. The alignment assembly portion **22***a* and the base portion **52***a* are preferably both constructed of a sturdy material, such as plastics; thermoplastics such as polyvinyl chloride (PVC), polyethylene (PE), polypropylene (PP), or another suitable thermoplastic; acrylic; metals; or other suitable sturdy materials.

As shown in FIG. **2**A, the base portion **52***a* comprises a first portion **54** and a second portion **70**. As shown in FIGS. **2**A-**2**B, in this embodiment of the doctor blade alignment device **10**, such as in the form of the hand-held doctor blade alignment device **10***a*, the first portion **54** and the second portion **70** of the base portion **52***a* may preferably form a substantially L-shaped configuration **64***b*.

As shown in FIG. **2**A, the first portion **54** preferably comprises an elongated rectangular mounting portion **64***a* having a first end **56***a*, a second end **56***b*, and a plurality of edges **58**, such as four edges **58**. As further shown in FIG. **2**A, the first portion **54** may comprise at least two insert openings **60**. The insert openings **60** are preferably spaced apart from each other and with one insert opening **60** formed through the surface of the first portion **54** near the first end **56***a*, and one insert opening **60** formed through the surface of the first portion **54** near the second end **56***b*.

As further shown in FIG. **2**A, the second portion **70** preferably comprises an elongated extending portion **66***a* having a first end **68***a*, a second end **68***b*, and an outer side **72***a* having

an elongated slot opening **74**. The elongated slot opening **74** is preferably configured to be gripped or held by a user or operator to grip or hold the hand-held doctor blade alignment device **10***a* when in use.

As further shown in FIGS. **2**A-**2**B, an inner side **72***b* of the base portion **52***a* may comprise one or more support portions configured for supporting and positioning the doctor blade alignment device **10** on and to the toner hopper **20** (see FIG. **1**) during alignment of the doctor blade **12** (see FIG. **1**) in the toner hopper **20**. The one or more support portions may comprise one or more of a first support portion **62** (see FIGS. **2**A-**2**B and FIG. **4**) on the first portion **54** (see FIG. **2**A) of the base portion **52***a*, a second support portion **76** (see FIG. **2**B and FIG. **4**) on the second portion **70** (see FIG. **2**A) of the base portion **52***a*, and a third support portion **75** (see FIG. **4**) on the second portion **70** (see FIG. **2**A) of the base portion **52***a* (see FIG. **4**).

FIG. **4** is a side view of the doctor blade alignment device **10**, such as in the form of the hand-held doctor blade alignment device **10***a*, of the disclosure. When the doctor blade alignment device **10**, such as in the form of a hand-held doctor blade alignment device **10***a*, is fully assembled such as shown in FIG. **2**A and FIG. **4**, the blade adjustment elements **36***a* are preferably inserted through the slot through openings **30**, the slot through openings **50**, and the insert openings **60**, to attach together the alignment assembly portion **22***a*, the adjustable setting blade **42***a*, and the base portion **52***a*. As shown in FIG. **4**, the adjustable setting blade **42***a* is attached between the alignment assembly portion **22***a* and the base portion **52***a*. As further shown in FIG. **4**, the first support portion **62** of the base portion **52***a*, the second support portion **76** of the base portion **52***a*, and the third support portion **75** of the base portion **52***a* may be formed in various shapes and such shapes may vary depending on the configuration of the toner hopper **20** and printer cartridge **11** used in the alignment of the doctor blade **12** (see FIG. **1**).

The alignment assembly portion **22***a* (see FIG. **2**A) and the adjustable setting blade **42***a* (see FIG. **2**A) calibrate the doctor blade alignment device **10** (FIG. **2**A) to obtain a doctor blade alignment setting for aligning a doctor blade **12** (see FIG. **1**) in a toner hopper **20** (see FIG. **1**) of a printer cartridge **11** (see FIG. **1**), such as a remanufactured printer cartridge **11***a* (see FIG. **1**).

FIGS. **3**A-**3**E show another embodiment of the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, for mounting to a toner hopper **20** (see FIG. **3**C) of a printer cartridge **11** (see FIG. **1**). FIG. **3**A is a back perspective view of another one of the embodiments of the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, of the disclosure. FIG. **3**B is a front perspective view of the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, of FIG. **3**A.

As shown in FIGS. **3**A-**3**B, the doctor blade alignment device **10**, such as in the form of the mountable doctor blade alignment device **10***b*, comprises an alignment assembly portion **22***b*. The alignment assembly portion **22***b* (see FIG. **3**A) comprises a doctor blade contact portion **26***a* preferably in the form of an elongated rectangular bar **26***b*. As shown in FIG. **3**A, the alignment assembly portion **22***b* comprises a first end **24***a*, a second end **24***b* and at least two openings **25** along a sidewall **28** (see FIG. **2**A). As shown in FIGS. **3**A-**3**B, alignment assembly portion **22***b* further comprises two slot through openings **30**. The slot through openings **30** are preferably spaced apart from each other and with one slot through opening **30** formed through the surface of the alignment assembly portion **22***b* near the first end **24***a*, and the other slot through opening **30** formed through the surface of the alignment assembly portion **22***b* near the second end **24***b*.

As shown in FIG. **3**B, the alignment assembly portion **22***b* further comprises at least two magnet elements **40**. The at least two magnet elements **40** are spaced apart along the alignment assembly portion **22***b* and are configured to contact the support portion **14** (see FIG. **3**E) of the doctor blade **12** (see FIG. **3**E) during alignment of the doctor blade **12** in the toner hopper **20** (see FIG. **3**E).

As shown in FIGS. **3**A-**3**B, the alignment assembly portion **22***b* further comprises at least two blade adjustment elements **36***b*, such as in the form of screws, bolts, or other suitable insertable fastener-type devices. Each blade adjustment element **36***b* (see FIGS. **3**A-**3**B) is preferably configured for insertion through each respective slot through opening **30** (see FIG. **3**A) in the alignment assembly portion **22***b*. Each slot through opening **30** is configured to receive each blade adjustment element **36***b*. In this embodiment, the blade adjustment elements **36***b* are not used with the collar device **32** (see FIG. **2**A) but other embodiments may use the blade adjustment element **36***a* (see FIG. **2**A) with the collar device **32**.

As shown in FIG. **3**B, the alignment assembly portion **22***b* further comprises at least two setting pin elements **38** spaced apart along the alignment assembly portion **22***b* and configured to contact the support portion **14** (see FIG. **1**) of the doctor blade **12** (see FIG. **1**) during alignment of the doctor blade **12** in the toner hopper **20** (see FIG. **1**).

As shown in FIGS. **3**A-**3**B, the doctor blade alignment device **10**, such as in the form of the mountable doctor blade alignment device **10***b*, further comprises an adjustable setting blade **42***b* that is preferably attached to the alignment assembly portion **22***b* and is substantially coextensive in length with the alignment assembly portion **22***b*. As shown in FIGS. **3**A-**3**B, the adjustable setting blade **42***b* preferably comprises an elongated rectangular blade **46***a* comprised of a metal material, such as stainless steel, steel, or another suitable metal material. The adjustable setting blade **42***b* (see FIG. **3**A) is similar to the adjustable setting blade **42***a* (see FIG. **2**A) that comprises the first end **44***a*, the second end **44***b*, and the plurality of straight edges **48**, such as four straight edges **48**. The adjustable setting blade **42***b* may further similarly comprise two slot through openings **50** (see FIG. **2**A) as shown with the adjustable setting blade **42***a*.

As shown in FIGS. **3**A-**3**B, the doctor blade alignment device **10**, such as in the form of the mountable doctor blade alignment device **10***b*, further comprises a base portion **52***b* that is preferably attached to the adjustable setting blade **42***b* and is substantially coextensive in length with the adjustable setting blade **42***b* as well as substantially coextensive in length with the alignment assembly portion **22***b*. The alignment assembly portion **22***b* and the base portion **52***b* are preferably both constructed of a sturdy material, such as plastics; thermoplastics such as polyvinyl chloride (PVC), polyethylene (PE), polypropylene (PP), or another suitable thermoplastic; acrylic; metals; or other suitable sturdy materials.

As shown in FIGS. **3**A-**3**B, the base portion **52***b* comprises a first portion **54** and a second portion **70**. In this embodiment of the base portion **52***b*, the first portion **54** may comprise a movable connector portion **78** (see FIGS. **3**A-**3**B) attached to a portion of a lower surface **46***b* (see FIG. **3***b*) of the adjustable setting blade **42***b* and substantially coextensive in length with the adjustable setting blade **42***b*. As shown in FIGS. **3**A-**3**B, the movable connector portion **78** preferably comprises an elongated pivotable hinge **79** connected between the base portion **52***b* and the adjustable setting blade **42***b* and capable

of pivotable movement to move the alignment assembly portion **22***b* and the adjustable setting blade **42***b* upwardly and downwardly as desired when mounting the doctor blade alignment device **10**, such as in the form of the mountable doctor blade alignment device **10***b*, to the toner hopper **20** (see FIG. **3**E). As shown in FIGS. **3**A-**3**B, the hinged portion **78** has a first end **80***a*, a second end **80***b*, an elongated rod element **87** (see FIG. **3**A), and hinge elements **88** (see FIG. **3**B).

As shown in FIGS. **3**A-**3**B, in this embodiment of the base portion **52***b*, the second portion **70** may comprise an elongated extending portion **66***b* having a first end **68***a*, a second end **68***b*, and an outer side **86***a*. In this embodiment, the outer side **86***a* is smooth and flat and does not have an elongated slot opening **74** (see FIG. **2**A) for hand-held use.

As shown in FIGS. **3**A-**3**B, in this embodiment of the base portion **52***b*, the base portion **52***b* may further comprise two or more attachment elements **82**, such as in the form of screws, bolts, or another suitable attachment element, inserted into a bottom portion of the base portion **52***b*. Each attachment element **82** may be secured to the base portion **52***b* with an attachment element securing portion **84**, such as a nut, washer, collar, or other suitable attachment element securing portion. The attachment elements **82** may be used to secure the movable connector portion **78** to the base portion **52***b* and/or may be used to connect the base portion **52***b* to the toner hopper **20** (see FIG. **3**C), to the printer cartridge **11** (see FIG. **1**), to a fixture (not shown) for holding the printer cartridge **11**, or to another suitable structure during the alignment of the doctor blade **12** (see FIG. **1**) with the doctor blade alignment device **10**, such as in the form of the mountable doctor blade alignment device **10***b*.

FIG. **3**C is a side perspective view of the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, of FIG. **3**A in a first pre-alignment position **100***a* with respect to a doctor blade **12** in a toner hopper **20**. During the alignment method, as shown in FIG. **3**C, the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, is positioned in area **96** over the toner hopper **20**, so that the alignment assembly portion **22***b* and adjustable setting blade **42***b* are positioned over the support portion **14** of the doctor blade **12**. As shown in FIG. **3**C, the support portion **14** of the doctor blade **12** is attached to the toner hopper **20** with the fastener member **18**, and the blade portion **16** is suspended below the support portion **14**. As further shown in FIG. **3**C, a contact portion **15** of the support portion **14** is positioned in the toner hopper **20** and forms a first gap **92** and a second gap **94** between the support portion and the toner hopper **20**.

FIG. **3**D is a side perspective view of the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, of FIG. **3**C in a second pre-alignment position **100***b* with respect to the doctor blade **12** in the toner hopper **20**. During the alignment method, as shown in FIG. **3**E, alignment assembly portion **22***b* and adjustable setting blade **42***b* are moved downwardly with the movable connector portion **78**, to be in the second pre-alignment position **100***b*.

FIG. **3**E is a side perspective view of the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, of FIG. **3**D in an alignment position **100***c* with respect to the doctor blade **12** in the toner hopper **20**. As shown in FIG. **3**E, the doctor blade alignment device **10**, such as in the form of a mountable doctor blade alignment device **10***b*, is positioned on the toner hopper **20** in the alignment position **100***c* for aligning a doctor blade **12** for calibration or setting of the doctor blade alignment setting and/or for aligning the doctor blade **12** for alignment in a printer cartridge **11** (see FIG. **1**) such as a remanufactured printer cartridge **11***a* (see FIG. **1**). As further shown in FIG. **3**E, the base portion **52***b* is mounted on the toner hopper **20** and contacts the toner hopper **20** at contact area **102**, the adjustable setting blade **42***b* is inserted into the second gap **94** (see FIG. **3**C) and contacts the toner hopper **20** at contact area **104**, and the magnets **40** of the alignment assembly portion **22***b* are in contact with the contact portion **15** of the support portion **14** of the doctor blade **12** at contact area **106**. In addition, the setting pin elements **38** (see FIG. **3**B) not viewable in FIG. **3**E are in contact with the support portion **14** of the doctor blade **12**. The doctor blade **12** may be moved up or down to increase or decrease the thickness of the first gap **92**. The thickness of the first gap **92** may vary depending on the model of the printer cartridge and the thickness of the first gap **92** may be in a typical range of 0.5 mm to 1.5 mm (millimeters), and preferably 1 mm. In addition, when the doctor blade **12** is moved up or down, this, in turn, may move the blade portion **16** up or down to obtain a desired contact position of the blade portion **16** to contact a developer roller (not shown) and to optimize contact with toner on the developer roller. In addition, during alignment, the blade adjustment elements **36***b* (see FIG. **3**E) may be loosened or tightened to adjust the adjustable setting blade **42***b* and to set a setting of an original equipment manufacturer (OEM) known doctor blade prior to use or to align a doctor blade **12** in a printer cartridge **11** (see FIG. **1**), such as remanufactured printer cartridge **11***a*.

There is provided in another embodiment a method **200** for aligning a doctor blade **10** (see FIG. **1**) in a toner hopper **20** (see FIG. **1**) of a printer cartridge **11** (see FIG. **1**), such as a remanufactured printer cartridge. FIG. **7** is an illustration of a flow diagram of an embodiments of the method **200** of the disclosure. As shown in FIG. **7**, the method **200** comprises step **202** of providing a doctor blade alignment device **10** (see FIG. **1**) comprising at least an alignment assembly portion **22***a* (see FIG. **2**A) or alignment assembly portion **22***b* (see FIG. **3**A), and comprising an adjustable setting blade **42***a* (see FIG. **2**A) or adjustable setting blade **42***b* (see FIG. **3**A).

As further shown in FIG. **7**, the method **200** further comprises step **204** of calibrating the doctor blade alignment device **10** with the alignment assembly portion **22***a*, **22***b* and the adjustable setting blade **42***a*, **42***b* to obtain a doctor blade alignment setting. The alignment assembly portion **22***a*, **22***b* comprises at least two blade adjustment elements **36***a*, **36***b* (see FIGS. **2**A, **3**A). The calibrating step **204** further comprises loosening the at least two blade adjustment elements **36***a* or **36***b*, adjusting the adjustable setting blade **42***a* or **42***b* to a desired doctor blade alignment setting, and tightening the at least two blade adjustment elements **36***a* or **26***b* to set the desired doctor blade alignment setting.

As further shown in FIG. **7**, the method **200** further comprises step **206** of positioning a doctor blade **12** (see FIGS. **1**, **3**E) in a toner hopper **20** (see FIGS. **1**, **3**E) of a printer cartridge **11** (see FIG. **1**). As further shown in FIG. **7**, the method **200** further comprises step **208** of coupling the doctor blade alignment device **10** to the doctor blade **12** (see FIGS. **1**, **3**E). The alignment assembly portion **22***a* or **22***b* comprises at least two magnet elements **40** (see FIG. **2**A, **3**B). The coupling step **208** further comprises loosely attaching the doctor blade **12** (see FIGS. **1**, **3**E) to the toner hopper **20** (see FIGS. **1**, **3**E) and contacting and coupling a support portion **14** (see FIGS. **1**, **3**E) of the doctor blade **12** with the at least two magnet elements **40** to retain the doctor blade **12** in place.

As further shown in FIG. **7**, the method **200** further comprises step **210** of aligning the doctor blade **10** in the toner

hopper **20** of the printer cartridge **11** with the doctor blade alignment setting of the doctor blade alignment device **10**. The aligning step **210** further comprises aligning the doctor blade **12** (see FIGS. **1**, **3**E) by contacting and aligning the support portion **14** of the doctor blade **12** with at least two setting pin elements **38** (see FIG. **1**) spaced apart along the alignment assembly portion **22***a* or **22***b*, and tightly attaching the doctor blade **12** to the toner hopper **20** of the printer cartridge **11** (see FIG. **1**). The aligning step **210** further comprises aligning the doctor blade **12** in the toner hopper **20** of a remanufactured printer cartridge **11***a* (see FIG. **1**) with the doctor blade alignment setting of the doctor blade alignment device **10**.

The doctor blade alignment device **10** further comprises a base portion **52***a* (see FIG. **2**A) or elongated base portion **52***b* (see FIG. **2**B), attached to the adjustable setting blade **42***a*, **42***b*. In one embodiment, the base portion **52***a* has one or more positioning portions **62**, **75**, **76** (see FIGS. **2**A, **4**) configured to secure the doctor blade alignment device **10***a* to the toner hopper **20** during alignment of the doctor blade **12** in the toner hopper **20**. In one embodiment, the base portion **52***a* comprises an elongated slot opening **74** (see FIG. **2**A) for hand-held use. In another embodiment, the base portion **52***b* comprises a movable connector portion **78** between the base portion **52***b* and the adjustable setting blade **42***b*.

There is provided in another embodiment a doctor blade alignment device **10** (see FIG. **1**) for aligning a doctor blade **12** (see FIG. **1**) in a toner hopper **20** (see FIG. **1**) of a remanufactured printer cartridge **11** (see FIG. **1**). The doctor blade alignment device **10** comprises an alignment assembly portion **22***a* (see FIG. **2**A), **22***b* (see FIG. **3**A) comprising a doctor blade contact portion **26***a* (see FIGS. **2**A, **3**A) with at least two magnet elements **40** (see FIGS. **2**A, **3**B), at least two setting pin elements **38** (see FIGS. **2**A, **3**B), and at least two blade adjustment elements **36***a* (see FIG. **2**A) or **36***b* (see FIG. **3**A). The doctor blade alignment device **10** further comprises an adjustable setting blade **42***a* (see FIG. **2**A) or **42***b* (see FIG. **3**A) attached to the alignment assembly portion **22***a* or **22***b*, respectively, and substantially coextensive in length with the alignment assembly portion **22***a* or **22***b*, respectively. The doctor blade alignment device **10** further comprises a base portion **52***a* (see FIG. **2**A) or **52***b* (see FIG. **3**A). In one embodiment, the base portion **52***a* has a having an elongated hinged portion attached to the adjustable setting blade, and the elongated hinged portion is substantially coextensive in length with the adjustable setting blade. The alignment assembly portion and the adjustable setting blade set the doctor blade alignment device to obtain a doctor blade alignment setting for aligning a doctor blade in a toner hopper of a remanufactured printer cartridge. In one embodiment, the base portion **52***a* comprises an elongated slot opening **74** (see FIG. **2**A) for hand-held use. In another embodiment, the base portion **52***b* comprises a movable connector portion **78** between the base portion **52***b* and the adjustable setting blade **42***b*.

The alignment assembly portion **22***a* (see FIG. **2**A) or **22***b* (see FIG. **3**A) further comprises slot through openings **30** (see FIGS. **2**A, **3**A). The adjustable setting blade **42***a* (see FIG. **2**A) or **42***b* (see FIG. **3**A) further comprises slot through openings **50** (see FIG. **2**A). The base portion **52***a* comprises two insert openings **60** (see FIG. **2**A). As shown in FIG. **2**A, the slot through openings **30**, the slot through openings **50**, and the insert openings **60** are preferably in alignment and are configured to receive the two blade adjustment elements **36***a*, respectively. The at least two setting pin elements maintain a repeatable tolerance for the doctor blade alignment setting.

It can now be realized that the doctor blade alignment device **10** (see FIG. **1**), such as in the form of the hand-held doctor blade alignment device **10***a* (see FIG. **2***a*), and the mountable doctor blade alignment device **10***b* (see FIG. **3**A), and the related alignment method **200** (see FIG. **7**) disclosed herein provide numerous advantages over known devices and methods, including but not limited to the following: provides a device and method that effectively aligns and positions a doctor blade with respect to a toner hopper and proximate to a developer roller or mag roller during assembly, manufacture, and remanufacture, which may be beneficial in allowing the doctor blade to regulate the toner amount on the developer roller or mag roller, and which may result in maximizing print quality during printing; provides a device and method that uses an alignment assembly portion with magnet elements at both ends to draw the doctor blade firmly against the setting pin elements at both ends, which may eliminate or minimize the need for an assembler or user to manually hold the doctor blade in order to tighten the fastener members to secure the doctor blade to the toner hopper; provides a device and method that may eliminate assembler or user mishandling, minimize rejected parts, and decrease assembly, manufacture, or remanufacture time; provides a device and method that does not require the use of permanently attached spacers, inserts, shims, or other spacing elements which may increase the overall cost and complexity and decrease the overall efficiency of the assembly, manufacturing, or remanufacturing processes; provides a method and device that aligns and positions a doctor blade within a toner hopper or a portion of a remanufactured toner printer cartridge to maximize printing quality of the remanufactured toner printer cartridge when it is in use with a laser printer device (not shown); provides a device and method that aligns and positions the doctor blade during replacement and remanufacture accurately and efficiently to an acceptable alignment or position point to maximize print quality during printing; provides a device and method having setting pin elements that allow and maintain repeatable tolerances of the doctor blade at both ends of the doctor blade; provides a device and method having blade adjustment elements at both ends of the device and that are designed to set or calibrate an OEM (original equipment manufacturing) setting or calibration of an OEM doctor blade prior to use as well as designed to set a doctor blade alignment setting for a replacement doctor blade, or a remanufactured doctor blade; provides a device and method that may only require a one time setting to set a doctor blade alignment setting, thus increasing efficiency and decreasing cost; and provides a method and device that provides magnet elements located near the positioning pins to facilitate holding the doctor blade in place and to attract the metallic doctor blade and keep it uniformly aligned during the doctor blade alignment and installation, thus allowing an assembler or user to freely align and mount and attach hands free the doctor blade with tightening the fastener members or screws.

Many modifications and other embodiments of the disclosure will come to mind to one skilled in the art to which this disclosure pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. The embodiments described herein are meant to be illustrative and are not intended to be limiting. Although specific terms are employed herein, they are used in a generic and descriptive sense only and for purposes of limitation. The invention is not limited in its application to the details of the construction and to the arrangement of the components set forth in the above description or as illustrated in the drawings.

What is claimed is:

1. A doctor blade alignment device for aligning a doctor blade in a toner hopper of a printer cartridge, the device comprising:

an alignment assembly portion comprising a doctor blade contact portion with at least two magnet elements and at least two blade adjustment elements;

an adjustable setting blade attached to the alignment assembly portion and substantially coextensive in length with the alignment assembly portion; and,

a base portion attached to the adjustable setting blade and substantially coextensive in length with the adjustable setting blade, the base portion comprising a hinged portion attached to the adjustable setting blade and substantially coextensive in length with the adjustable setting blade,

wherein the alignment assembly portion and the adjustable setting blade calibrate the doctor blade alignment device to obtain a doctor blade alignment setting for aligning a doctor blade in a toner hopper of a printer cartridge.

2. The device of claim 1 wherein the base portion comprises a holding portion and the doctor blade alignment device comprises a hand-held doctor blade alignment device.

3. The device of claim 1 wherein the alignment assembly portion further comprises at least two setting pin elements spaced apart along the doctor blade contact portion and configured to contact a support portion of the doctor blade during alignment of the doctor blade in the toner hopper.

4. The device of claim 1 wherein the at least two magnet elements are spaced apart along the doctor blade contact portion and are configured to contact a support portion of the doctor blade during alignment of the doctor blade in the toner hopper.

5. The device of claim 1 wherein the alignment assembly portion further comprises at least two alignment assembly portion through openings formed in the doctor blade contact portion, each alignment assembly portion through opening configured to receive each blade adjustment element.

6. The device of claim 1 wherein the adjustable setting blade comprises at least two adjustable setting blade through openings, each configured to receive each blade adjustment element.

7. The device of claim 1 wherein the base portion comprises at least two insert openings, and further comprises one or more positioning portions configured to secure the doctor blade alignment device to the toner hopper during alignment of the doctor blade in the toner hopper.

8. The device of claim 1 wherein the printer cartridge is a remanufactured printer cartridge.

9. A doctor blade alignment device for aligning a doctor blade in a toner hopper of a remanufactured printer cartridge, the device comprising:

an alignment assembly portion comprising a doctor blade contact portion with at least two magnet elements, at least two setting pin elements, and at least two blade adjustment elements;

an adjustable setting blade attached to the alignment assembly portion and substantially coextensive in length with the alignment assembly portion; and,

a base portion attached to the adjustable setting blade and substantially coextensive in length with the adjustable setting blade, the base portion comprising a hinged portion attached to the adjustable setting blade and substantially coextensive in length with the adjustable setting blade,

wherein the alignment assembly portion and the adjustable setting blade set the doctor blade alignment device to obtain a doctor blade alignment setting for aligning a doctor blade in a toner hopper of a remanufactured printer cartridge.

10. The device of claim 9 wherein the base portion comprises a holding portion, and the doctor blade alignment device comprises a hand-held doctor blade alignment device.

11. The device of claim 9 wherein the at least two setting pin elements maintain a repeatable tolerance for the doctor blade alignment setting.

12. A method for aligning a doctor blade in a toner hopper of a printer cartridge, the method comprising the steps of:

providing a doctor blade alignment device comprising at least an alignment assembly portion, an adjustable setting blade, and a base portion attached to the adjustable setting blade, the base portion having one or more positioning portions configured to secure the doctor blade alignment device to the toner hopper during alignment of the doctor blade in the toner hopper;

calibrating the doctor blade alignment device with the alignment assembly portion and the adjustable setting blade to obtain a doctor blade alignment setting;

positioning a doctor blade in a toner hopper of a printer cartridge;

coupling the doctor blade alignment device to the doctor blade; and,

aligning the doctor blade in the toner hopper of the printer cartridge with the doctor blade alignment setting of the doctor blade alignment device.

13. The method of claim 12 wherein the base portion comprises a holding portion and the doctor blade alignment device comprises a hand-held doctor blade alignment device.

14. The method of claim 12 wherein the alignment assembly portion comprises at least two blade adjustment elements, and wherein the calibrating step further comprises loosening the at least two blade adjustment elements, adjusting the adjustable setting blade to a desired doctor blade alignment setting, and tightening the at least two blade adjustment elements to set the desired doctor blade alignment setting.

15. The method of claim 12 wherein the alignment assembly portion comprises at least two magnet elements, and wherein the coupling step further comprises loosely attaching the doctor blade to the toner hopper and contacting and coupling a support portion of the doctor blade with the at least two magnet elements to retain the doctor blade in place.

16. The method of claim 15 wherein the aligning step further comprises aligning the doctor blade by contacting and aligning the support portion of the doctor blade with at least two setting pin elements spaced apart along the alignment assembly portion, and tightly attaching the doctor blade to the toner hopper of the printer cartridge.

17. The method of claim 12 wherein the aligning step further comprises aligning the doctor blade in the toner hopper of a remanufactured printer cartridge with the doctor blade alignment setting of the doctor blade alignment device.

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